Roll No. _____

Please check that this question paper contains 33 questions and 12 printed pages.

CLASS–XI
CHEMISTRY
ANNUAL EXAM (2020-21)

Time allowed : 3 hours   **Maximum Marks : 70**

General Instructions :

Read the following instructions carefully :

(a) *There are 33 questions in the question paper. All questions are compulsory.*

(b) *Section A : Q. No. 1 and 2 are case based questions having four MCQs or Reason-Assertion type based on given passage each carrying 1 mark.*

(c) *Section A : Question 3 to 16 are MCQs and Reason Assertion type questions carrying 1 mark each.*

(d) *Section B : Q. No. 17 to 25 are short answer questions and carry 2 marks each.*

(e) *Section C : Q. No. 26 to 30 are short answer questions and carry 3 marks each.*

(f) *Section D : Q. No. 31 to 33 are long answer questions carrying 5 marks each.*

(g) *There is no overall choice in the question paper. However, internal choice have been provided.*

(h) *Use of calculators and log tables is not permitted.*

Section-A

Read the passage given below and answer the following questions :

1.   On combustion in excess of air, lithium forms mainly the oxide, Li_2O, sodium forms the peroxide, Na_2O_2 while potassium, rubidium and caesium forms the superoxides, MO_2. Under appropriate conditions pure compounds M_2O, M_2O_2 and MO_2 may be prepared. The increasing stability of the peroxide or superoxide, as the size of the metal ion increases, is due to the stabilisation of large anions by larger cations through lattice energy effects. These oxides are easily hydrolysed by water to form the hydroxides.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) Alkali metals react with water vigorously to form hydroxides and dihydrogen. Which of the following alkali metals reacts with water least vigorously ?

    (a) Li   (b)   Na

    (c) K   (d)   Cs

(ii) Metal carbonates decompose on heating to give metal oxide and carbon dioxide. Which of the metal carbonates is most stable thermally ?

    (a) $MgCO_3$ (b) $CaCO_3$

    (c) $SrCO_3$ (d) $BaCO_3$

(iii) Wich of the following compound is readily soluble in water ?

    (a) $BeSO_4$ (b) $MgSO_4$

    (c) $BaSO_4$ (d) $SrSO_4$

(iv) Which one of the following compounds is a peroxide ?

    (a) KO_2 (b) BaO_2

    (c) MnO_2 (d) NO_2

OR

Which of the following are the correct reasons for anomalous behaviour of lithium ?

    (a) Exceptionally small size of its atom

    (b) Its high polarizing power

    (c) It has high degree of hydration

    (d) Exceptionally low ionization enthalpy

Read thepassage given below and answer the following questions :

2. If hydrogen fuel cell vehicles capture a significant fraction of the mandated zero emission vehicle (ZEV) market, a large demand for hydrogen could develop over the next 15 years. If PEMFC (proton exchange membrane fuel cell) cars accounted for half the mandated ZEV population, there would be about 3,50,000 fuel cell cars on

the road in India by 2030, requiring 55 million scf (standard cubic foot) of hydrogen per day. (This is comparable to the amount of Hydrogen produced in a typical oil refinery today).

The basic principle of hydrogen economy is the transportation and storage of energy in the form of liquid or gaseous dihydrogen. Advantage of hydrogen economy is that energy is transmitted in the form of dihydrogen and not as electric power. It is for the first time in the history of India that a pilot project using dihydrogen as fuel was launched in October 2005 for running automobiles.

In these questions (all four parts), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices :

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** Atomic hydrogen is more reactive than nascent hydrogen.

   Reason : The energy content of atomic hydrogen is more than nascent hydrogen.

(ii) **Assertion :** H_2O is an example of electron rich hydride.

   Reason : All non-metal forms electron rich hydride.

(iii) **Assertion :** Hydrogen shows resemblance with alkali metals as well as halogens.

   Reason : Hydrogen exists in atomic form only at high temperature.

OR

   Assertion : Some metals like platinum and palladium, can be used as storage media for hydrogen.

   Reason : Platinum and palladium can absorb large volume of hydrogen.

(iv) **Assertion :** Dihydrogen relatively inert at room temperature.

   Reason : High H-H bond enthalpy make Di-hydrogen inert at room temperature.

3

Following questions (No. 3–11) are multiple choice questions carrying 1 mark each :

3. Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons ?

   (a) Pauli's exclusion principle

   (b) Heisenberg's uncertainty principle

   (c) Hund's rule of maximum multiplicity

   (d) Aufbau principle

4. In which of the following compounds, an element exhibits two different oxidation states ?

   (a) NH_2OH (b) NH_4NO_3

   (c) N_2H_4 (d) N_3H

   OR

   Identify the correct statement(s) in relation to the following reaction :

   $$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$
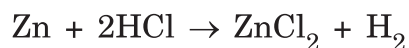
   (a) Zinc is acting as an oxidant

   (b) Chlorine is acting as a reductant

   (c) Hydrogen ion is acting as an oxidant

   (d) Zinc is acting as a reductant

5. The enthalpies of elements in their standard states are taken as zero. The enthalpy of formation of a compound :

   (a) is always negative   (b) is always positive

   (c) may be positive or negative   (d) is never positive

6. 16 g of oxygen has the same number of molecules as present in :

   (a) 16 g of CO   (b) 28 g of N_2

   (c) 42 g of N_2 (d) 1.0 g of H_2

   OR

The empirical formula and molecular mass of a compound are CH_2O and 180 g respectively. What will be the molecular formula of the compound ?

(a) $C_9H_{18}O_9$

(b) CH_2O

(c) $C_6H_{12}O_6$

(d) $C_2H_4O_2$

7. The electromeric effect is :

(a) Permanent effect

(b) Temporary effect

(c) π-electrons transfer in this effect

(d) Both (b) and (c)

8. The reaction of $CH_3CH = CH_2$ with HOCl will yield :

(a) 2-chloro-1-propanol

(b) 3-chloro-2-propanol

(c) 1-chloro-2-propanol

(d) 1-chloro-1-propanol

OR

2-Bromopentane is heated with potassium ethoxide in ethanol. The major product obtained is :

(a) pent-2-ene

(b) Pent-1-ene

(c) 2-ethoxypentane

(d) 1-ethoxypentane

9. Which one of the following species does not exist under normal conditions ?

(a) Li_2

(b) Be_2^+

(c) Be_2

(d) B_2

OR

Stable form of C may be represented by the formula :

(a) C

(b) C_2

(c) C_3

(d) C_4

10. Consider the following gaseous equilibrium with equilibrium constants K_1 and K_2 respectively :

$$SO_2(g) + \frac{1}{2} O_2(g) \rightleftharpoons SO_3(g)$$

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$$

The equilibrium constants are related as :

(a) $K_1^2 = \dfrac{1}{K_2}$ (b) $2K_1 = K_2^2$

(c) $K_2 = 2/K_1$ (d) $K_2^2 = 1/K_1$

11. Which of the following is a Lewis acid ?

(a) $MgCl_2$ (b) $CaCl_2$

(c) $AlCl_3$ (d) NH_3

In the following questions (Q. No. 12-16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices :

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

12. **Assertion :** Angular momentum of an electron in an atom is quantized.

Reason : In an atom only those orbits are permitted in which angular momentum of the electron is a natural number multiple of $h/2\pi$.

13. **Assertion :** All reactions which are exothermic are spontaneous.

Reason : All reactions in which entropy increases are spontaneous.

14. **Assertion :** The IUPAC name of $CH_2=CH–C\equiv CH$ is but-3-en-1-yne.

Reason : The priority of triple bond is more than double bond.

6

15. **Assertion :** Methane cannot be prepared by kolbe electrolytic reaction.

Reason : In this reaction alkane is liberated at anode.

16. **Assertion :** Carbon shows anomalous behaviour in group–14.

Reason : Carbon has maximum covalency of 4.

OR

Assertion : All the oxides of boron family with the general formula M_2O_3 are basic.

Reason : From B_2O_3 to Tl_2O_3 basic character decreases.

Section-B

17. (i) Give two points of difference between σ and π-bond.

(ii) Using VSEPR theory, name the shapes of SF_4 and I_3^- molecules.   1+1=2

18. Calculate the pH of a 0.001 M solution of $Ba(OH)_2$ assuming it to be completely ionized.   2

19. Permanganate ion (MnO_4^-) reacts with sulphur dioxide gas in acidic medium to produce Mn^{2+} and hydrogensulphate ion. (Balance by ion-electron method)   2

OR

Whenever a reaction between an oxidising agent and a reducing agent is carried out, a compound of lower oxidation state is formed if the reducing agent is in excess and a compound of higher oxidation state is formed if oxidising agent is in excess. Justify this statement giving two illustrations. (Chemical Reactions)

20. (i) The IUPAC name for $CH_3COCH(CH_3)CH=CHCOH$

(ii) Name the isomerism shown by following compounds :

$CH_3CH_2CH_2CH_2NH_2$, $CH_3CH_2NH\ CH_2CH_3$, $CH_3CH_2N(CH_3)_2$ 1+1=2

21. Answer the following questions :

(i) Out of bonding and antibonding molecular orbitals, the bonding molecular orbital has lower energy and higher stability. Why ?

(ii) Dipole moment values help in predicting the shapes of covalent molecules. Explain.   1+1=2

7

22. Arrange the following as per their property indicated against it ?

    (i)   I, Br, Cl , F (increasing negative electron gain enthalpy)

    (ii) Be, B, C, N, O (increasing first ionization enthalpy)   1+1=2

23. Draw the reasonating structures of Aniline and Nitrobenzene using the curved arrow
    for electronic movement.   2

<div align="center">**OR**</div>

Explain electrophiles and nucleophiles with examples.

24. Consider the following species :

    N^{3-} , O^{2-} , F^- , Na^+ , Mg^{2+} , Al^{3+}

    (a)   What is common in them ?

    (b)   Arrange them in order of increasing ionic radii.

25. The groups which direct the incoming group to ortho and para positions are called
    ortho and para directing groups. Some examples of ortho & para directing groups
    are : $- NH_2$, $-NHR$, $-NHCOCH_3$, etc. The groups which direct the incoming group
    to meta position are called meta directing groups. Some examples of meta directing
    groups are $-NO_2$, $-CN$, $-CHO$, $-COR$, $-COOH$, $-COOR$, $-SO_3H$, etc.

    Arrange the following set of compounds in order of their decreasing relative reactivity
    with an electrophile, E^+ :

    (i)   Chlorobenzene, 2,4-dinitrochlorobenzene, p-nitrochlorobenzene

    (ii) Toluene, $p-H_3C-C_6H_4-NO_2$, $p-O_2N-C_6H_4-NO_2$ 1+1=2

<div align="center">**OR**</div>

Why do alkenes prefer to undergo electrophilic addition reaction while arenes prefer
electrophilic substitution reaction ? Explain.

Section-C

26. (i) Although heat is a path function but heat absorbed by the system under certain specific conditions is independent of path. What are those conditions ?

(ii) The molar heat of formation of $NH_4 NO_3(s)$ is $- 365.5$ KJ/mol and those of $NO_2(g)$ and $H_2O_{(I)}$ are $+ 81.46$ and $- 258.78$ KJ/mol respectively at 25°C and 1 atm pressure. Calculate ΔU for the reaction.

$$NH_4NO_{3(s)} \rightarrow N_2O_{(g)} + 2H_2O_{(I)} \qquad\qquad 1+2=3$$

OR

(i) Given that $\Delta H = 0$ for mixing of two gases. Explain whether the diffusion of these gases into each other in a closed container is a spontaneous process or not ?

(ii) The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are $- 890.3$ KJ mol^{-1}, $- 393.5$ KJ mol^{-1} and $- 285.8$ KJ mol^{-1} respectively. Calculate the Enthalpy of formation of $CH_4(g)$ showing chemical equations involved. $\quad 1+2=3$

27. (i) Define buffer solution. Give example.

(ii) The solubility product of lead bromide is 8×10^{-5}. If the salt is 80% dissociated in saturated solution, find the solubility of the salt in moles per litre. $1+2=3$

OR

(i) Describe the effect of increase in pressure on following reaction in equilibrium:

$$2NOCl(g) \longrightarrow 2NO(g) + Cl_2(g)$$

(ii) At a certain temperature equilibrium constant (K_c) is 16 for the reaction :
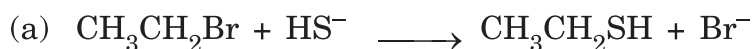
$$SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$$

If we take one mole of each of the four gases in one litre container, what would be the equilibrium concentration of NO and NO_2 ? $\qquad\qquad 1+2=3$

28. Explain the following :

   (i) CO_2 is a gas whereas SiO_2 is a solid.

   (ii) Silicon forms SiF_6^{2-} ion whereas corresponding fluoro compound of carbon is not known.

   (iii) Gallium has higher ionisation enthalpy than aluminium.   1×3=3

29. (i) Classilfy the following reactions in one of the reaction type :

   (a) $CH_3CH_2Br + HS^- \longrightarrow CH_3CH_2SH + Br^-$

   (b) $(CH_3)_2C=CH_2 + HCl \longrightarrow (CH_3)_2CCl–CH_3$

   (ii) Arrange the following species in the decreasing order of their stability :

   (a) (I) $CH_3CH(CH_3)CH_2\ CH_2^+$

         (II) $CH_3CH(CH_3)CH^+CH_3$

         (III) $CH_3C^+(CH_3)\ CH_2CH_3$

         (IV) $^+CH_2CH(CH_3)CH_2CH_3$

   (b) (I) $CH_3\ CH_2^-$

         (II) $CH_2=CH^-$

         (III) $(CH_3)C^-$

         (IV) $(CH_3)_2CH^-$ 1+2=3

30. (i) Volume of a solution changes with change in temperature, then, will the molality of the solution be affected by temperature ? Give reason for your answer.

   (ii) A sample of Sodium nitrate weighing 0.83 g is placed in a 50 ml volumetric flask. The flask is then filled with water to the mark on the neck. What is the molarity of the solution ?   1+2=3

10

Section-D

31. (i) (a) Write two wrong assumptions of the kinetic molecular theory of gases which led to the failure of the ideal gas law.

    (b) Boyle's law states that at constant temperature, if pressure is increased on a gas, volume decrease and vice-versa. But when we fill air in a balloon, volume as well as pressure increases, why ?

    (ii) A neon-dioxygen mixture contains 70.6 g dioxygen and 167.5 g neon. If pressure of the mixture of gases in the cylinder is 25 bar. What is the partial pressure of dioxygen and neon in the mixture ?   2+3=5

OR

    (i) (a) Write any two postulates of kinetic theory of gases.

    (b) The compressibility factor Z for a gas is less than one. What does it signify?

    (ii) Pressure of 1 g of an ideal gas A at 27°C is found to be 2 bar. When 2 g of another ideal gas B is introduced in the same flask at same temperature, the pressure becomes 3 bar. Find the relationship between their molecular masses.   2+3=5

32. (i) (a) Find the number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number +3.

    (b) If kinetic energy of a particle is doubled. What will happen to de Broglie wavelength as compared to previous de Broglie wavelength ?

    (ii) If the position of the electron is measured within an accuracy of ± 0.002 nm, calculate the uncertainty in the momentum of the electron. Suppose the momentum of the electron is h4π × 0.05 nm. Is there any problem in defining this value ?   2+3=5

OR

11

(i) (a) State Hund's rule of maximum multiplicity.

(b) Write electronic configuration of Cr^{3+} (24).

(ii) If the photon of the wavelength 150 pm strikes an atom, one of its inner bound electrons is ejected out with a velocity of 1.5×10^7 ms^{-1}. Calculate the energy with which it is bound to the nucleus.

33. (i) Examplify the following name reactions : (Chemical Equation only) :

(a) Wurtz reaction

(b) Decarboxylation

(ii) How will you bring out the following conversions ?

(a) Acetylene to ethane

(b) Benzene to methyl benzene

(c) Ethanol to ethene $\qquad$ 2+3=5

OR

(i) Distinguish between propene and propane.

(ii) Explain the stepwise mechanism for the Bromination of benzene.

(iii) 1-Phenylbut-1-ene undergo the reuctive ozonolysis. Analysing the information:

(a) Write the reaction for reuctive ozonolysis of 1-Phenylbut-1-ene.

(b) Give IUPAC name of products obtained. $\qquad$ 1+2+2=5

□□□